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THE BLOOD IN SCARLET FEVER.*

WILDER TILESTON AND EDWIN A. LOCKE,
Boston.

THE absence of any exhaustive study of the blood changes occurring in measles and scarlet fever together with the suggestions offered by various incomplete reports from the literature of certain characteristic alterations in the blood of the two diseases led to an attempt on the part of the authors, in the spring of 1902, to make a systematic investigation of the subject. Such a study was made possible by the kindness of the visiting physician of one of our large contagious hospitals constantly treating a large number of the above named diseases. The report of the results obtained in the case of measles has already been published by one of us (Tileston). The present paper includes the report of the simultaneous work done on scarlatina.

LITERATURE.

As in the case of measles, a careful search yields but a small literature on the blood alterations in scarlatina. In the following summary only the salient points of the articles are given.

Many of the earlier writers report only isolated observations or results based upon faulty or inconclusive methods. Leichtenstern (1878) called attention to a moderate anemia with leucocytosis and slight diminution in the reds in scarlatina. Halla (1883) found a considerable leucocytosis, in one case 22,506 per c.mm., and a reduction in the red cells to 3,656,000 per c.mm. Later Widowitz (1887) described a rapid diminution in the percentage of

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hemoglobin beginning a few days after onset and a slower rise during convalescence. Pick (1890) reports one case in which he found no leucocytosis during the fever. Peé, in the same year, from the incomplete study of four cases, described an increasing leucocytosis during the early stages which disappeared with the fever.

Hayem (1889) observed a moderate leucocytosis at the beginning of the rash (10,000 to 20,000), more marked if severe angina were present, a fall of about 10 per cent in the hemoglobin and a diminution of approximately one million in the count of erythrocytes. In the case of the red cells, the lowest counts occurred at the time of the fall in temperature.

The first systematic study of the blood in scarlatina was made by Kotschetkow in 1891. With respect to the blood changes, he divides the cases into three grades according to the number of white cells present, namely, 1) mild cases—10,000 to 20,000 leucocytes; 2) moderately severe cases—20,000 to 30,000 leucocytes; 3) severe or fatal cases—above 30,000 leucocytes. The whites reached 40,000 per c.mm. in several very severe cases. The increase in white cells begins from two to three days previous to the breaking out of the rash, reaches its maximum about the same length of time after its appearance and persists for a long period, finally sinking gradually to normal. Complications such as nephritis, otitis media and lymphadenitis as well as fever exert no influence on the number of leucocytes. The per cent of neutrophiles is increased in proportion to the severity of the disease. In mild or moderately severe cases the eosinophiles are normal or subnormal at the onset and rise gradually to reach their maximum during the second or third week (8 to 15 per cent); in the very severe cases they are usually diminished from the beginning and rapidly sink to zero. Contrary to the course of the neutrophiles, the lymphocytes are lessened at the onset but gradually increase during the later course of the disease. Kotschetkow believes these changes to be so constant as to be of considerable prognostic value. Beginning with the onset of the disease the number of red cells gradually sinks to about 3,000,000 per c.mm. or even lower, to rise again after the sixth week.

Rille (1892) made differential counts in three cases, two of which gave normal results. The third, terminating fatally showed a leucocytosis of 15,000 to 30,000 with a marked increase in the percentage of eosinophiles (5.31 to 7.7 per cent.)

In the study of ten cases, Rieder (1892), almost without exception, observed a considerable leucocytosis even after a prolonged period of normal temperature. Croupous pneumonia complicating one case caused an increase in the existing leucocytosis of only 1,600.

Felsenthal's (1892) results were derived from the study of six mild cases in children. The number of white cells in these varied from 18,000 to 30,000 per c. mm., and the red cells from 4,500,000 to 5,500,000. During the fever, angina and exanthem, he found a constant leucocytosis which after some weeks disappeared. The eosinophiles were increased somewhat at the time of the appearance of the exanthem (in one instance to 11 per cent), a few days later becoming less.

Zappert (1893) described an eosinophilia occurring in scarlet fever either during or just following the febrile stage. His highest count was 1,155 per

c.mm. (7.7 per cent). Studying normal children and adults, he found a higher percentage of eosinophiles in the former (four to six per cent).

Sobotka (1893) observed a leucocytosis during the incubation period of scarlet fever which persisted after the outbreak of the disease. He noted a similar leucocytosis in the incubation period of pneumonia, varicella, variola and measles.

A leucocytosis of 30,000–80,000 in oncoming scarlatina characterized at the end by a lymphocytosis was noted by Klein (1897).^{*} Two cases complicated by nephritis, and ending in convalescence, revealed an eosinophilia of 10 to 16.5 per cent, while a third of the same type, but ending fatally, gave only one per cent.

Van den Berg's (1898) observations were made on 16 cases, 12 followed over long periods. There was a leucocytosis of 20 to 30 days duration and with a maximum value on the third to sixth day in every case. So far as he could observe this was not affected by the severity of the disease or extent of the rash. No evidence appeared in his work to demonstrate any constant relation between complications and the white count. He does not consider a prolonged leucocytosis to signify a bad prognosis. Van den Berg ascribes the high red count at the onset as due to an increase in production of cells. Postfebrile anemia was seen in seven cases (reds frequently as low as 3,500,000 per c.mm.), in one with nephritis of a severe type. The hemoglobin showed wide variations though generally high in the beginning. The differential count was as follows:—polynuclear and transitional cells 68 to 82 per cent; mononuclear cells 16 to 28 per cent; eosinophiles 1.3 to 8 per cent. In all cases these counts gradually returned to normal after the disappearance of the fever, though in a few instances the mononuclears increased to 50 per cent.

The careful studies on two adult cases of scarlet fever by Türk (1898) furnished some new data. Like the earlier writers, he speaks of a decrease in the percentage of hemoglobin and red cells, and of an increase in the number of blood plates during desquamation. He found a slight leucocytosis at first which was quickly followed by a normal count for one to two days, then a second period of leucocytosis beginning at the height of the fever or occurring with desquamation. During the first period the polynuclear cells are increased, the mononuclears diminished and the eosinophiles normal or diminished, while in the second period there is an increase in the eosinophiles and mononuclears and transitionals with a corresponding decrease in the polynuclears. Türk's white counts ranged from 8,600 to 14,000 per c.mm. The second period is, he says, often obscured by complications.

Mackie (1901) examined 25 cases at various stages and found a constant anemia (reds 3,500,000 to 4,000,000) in one-half the cases. All showed more than 10,000 leucocytes, the numbers varying with the severity of the throat symptoms, but not with the temperature. In most cases the increase in the whites began 24 hours after the appearance of the rash, reaching their maximum on the third to the tenth day, but in fatal cases the count diminished as the disease progressed.

Reckzeh's (1902) work, based upon the study of ten cases in children, is more comprehensive and thorough than any previously published. The red

^{*}Cited by Reckzeh.

cells varied considerably during the course of the disease (3,500,000 to 5,000,000 per c.mm.) but as a rule there was present a slight anemia. This anemia, the author thinks, is not increased by the presence of nephritis. Slight poikilocytosis was present but without polychromatophilia or granular degeneration. A corresponding moderate decrease in the hemoglobin was noted. Blood plates seemed very abundant immediately after the subsidence of the fever. The leucocytosis presents a picture more or less characteristic. Normal on the first and second day, there is a sharp rise on the third or fourth which again begins to fall on the fifth to ninth day, the count finally reaching normal at the end of the second or early in the third week. The highest count reached 41,000 per c.mm. Lymphadenitis had a marked effect in raising the leucocyte count while nephritis was without influence in two cases.

Reckzeh did not find the "second period" of leucocytosis mentioned by Türk, nor any relation between the severity of the disease and the height of the white count. The abrupt rise in the polynuclear cells, corresponding to the increased leucocyte count, took place in the first few days of the disease and was followed by a gradual sinking which reached normal or lower at the end of the first week or ten days. The lymphocytes followed a somewhat opposite course, being much diminished during the first few days then slowly increasing to become normal or slightly increased in the third week. A less definite curve was present in the case of the eosinophiles which varied from 1 to 12½ per cent. There appeared to be a more or less exact relation between the highest per cent and the fading of the rash.

Bowie (1902) though recording blood examinations in 167 cases, for the most part made only isolated observations and his conclusions are in some respects less trustworthy than would have been the case had he studied fewer cases more in detail. Two cases developed a leucocytosis two or three days before the rash broke out. The maximum count was sometimes reached during the first week and the white count became normal at any time within the first three weeks, the amount and persistence of the leucocytosis depending on the severity. All fatal cases were accompanied by a low count either from the first or later, but such a condition did not invariably indicate a fatal termination. The most favorable cases were those with a very high leucocytosis. Temperature apparently exerted no influence. Adenitis, otitis media and nephritis, according to the author, produced a rise in the number of leucocytes which preceded by a brief period their appearance. Polynuclear leucocytes, Bowie says, are much increased at first but soon fall, reaching normal about the end of the third week, while the lymphocytes take an opposite course, being at first diminished and rising gradually with the fall in the polynuclears. The eosinophiles are more variable, in the ordinary cases sinking very low at first then rising to their maximum in the first week; in the very severe or fatal cases, and with complications, they are much reduced or entirely absent. Bowie believes the blood examination to be of considerable value both in diagnosis and prognosis.

Sacquépéé (1902) gives the results of his blood examinations in scarlatina in adults. His cases are divided into two groups: 1) Those with a regular course including 14 more or less grave cases, and 2) those with an irregular course, three showing complications and one ending fatally. In the first

group he found a high leucocytosis during the first three days, usually above 15,000 per c.mm., sometimes even 30,000, and after the first week rarely over 10,000. By the 20th day the number fell to 5,000 or 6,000. He was able to find no parallel between the severity of the disease and the degree of leucocytosis. During the first few days the percentage of polynuclear cells was far above the normal, often 90 per cent, but later constantly tending toward normal. The mononuclears in general followed a complementary course, the two lines finally crossing. Contrary to the course of the relative values, both types were always absolutely increased until late in convalescence when the polynuclears sank to normal. The eosinophiles at the onset, though relatively normal, were absolutely increased and by the fourth to fifth day reached even 13 per cent in some instances, remaining above normal for several weeks. The author occasionally found mononuclear eosinophiles and rarely noted the granular very small. The cases in the second group, or those with an irregular evolution, gave varying results.

Klotz, in 1904, published a most excellent paper on the leucocytosis in scarlet fever, in which he records the results of careful studies on a series of 14 cases varying from 2½ to 14 years. His division of cases is into three groups, namely: mild, medium and severe. In the first group the changes in the white cells are not striking and consist in a moderate increase in number and but a slight alteration in the proportions of the different types. In the second group, or those of moderate severity, the leucocytosis is invariably marked, as a rule 20,000 to 40,000 or even higher. The leucocytosis reaches its highest point on the third or fourth day after onset and subsequently falls gradually to normal at about the fourth to seventh week. An early increase in the polynuclear leucocytes takes place, rising to their maximum during the first week (in some instances as much as 93 per cent) and again falling to normal by the end of the third or fourth week. The lymphocytes show an opposite course. During the first week the eosinophiles are much decreased but by the second or third week usually increase to above normal (one case to 19 per cent), again declining to normal in the fifth week. A definite relation seems to exist between the severity of the disease and the number and character of staining of the eosinophiles. In severe cases the author finds a favorable significance in a high eosinophilia and "marked oxyphile nature of the polymorphonuclear leucocytes." Certain degenerative changes in the leucocytes are mentioned. In Klotz's series complications such as lymphadenitis, arthritis, varicella and otitis showed an increase of 4,000 to 12,000 in the number of leucocytes. The effects of nephritis were variable. The author's cases of the severe or malignant type were associated with a low leucocyte count and low percentage of eosinophiles. Evident degenerative changes were present in the white cells.

PERSONAL OBSERVATIONS.

Our investigations include the study of the blood of 34 cases of scarlatina, 28 of whom were between the ages of 2 and 10 years, one under 2 years, and the remaining 5 varying from 11 to 23 years. Since the patients were all observed in hospital

wards, it was seldom possible to make an examination of the blood previous to the second or third day, as the patients usually did not enter until the disease was well developed. On the other hand, the examinations, once begun, were continued until death in the fatal cases, or until the establishment of complete convalescence in those ending in recovery. Only such cases were selected as gave unmistakable evidence of the disease and remained under a constant régime of diet and treatment. In no instance was any medication used, other than small doses of strychnia, and even that in but few. With almost absolute uniformity the blood was taken about 9:30 A.M. or 4 P.M., in order to avoid any possible influence by the ingestion of food.

The methods and technique employed are essentially those described by Tileston in his paper on the blood in measles recently published in this journal, and the reader is referred to his report for details. In determining the percentage values of the various types of leucocytes, the lymphocytes, large and small, mononuclears and transitional forms were counted separately. These values, however, are manifestly subject to considerable variation, depending upon the standards of the observer. Furthermore, the study of the relative values thus obtained offered no suggestions which were not equally evident from the figures obtained by combining these four groups under one head, namely, "mononuclear cells." In the tables, therefore, these are grouped under the comprehensive term "mononuclears."

CASE 1.

SCARLATINA; MEASLES DURING CONVALESCENCE.

Male, 3½ years. Entered May 3. Past history negative. Onset April 30, with fever vomiting, and "spasms." Rash appeared next day.

Physical examination, May 3: Pale child, showing considerable prostration. Mouth and throat red; papillae of tongue enlarged; tonsils enlarged, with exudate on both; eruption on hard palate; bright punctate eruption over whole body. Heart normal. Urine: albumin absent, May 4-June 1.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclear	Mono-nuclears	Eosins	Myelocytes	Mast Cells	Remarks
May 6	7	102.5	80	31,400	4,832,000	73.2	21.2	4	1	0.6	Rash fading. Symptoms severe, thick yellow membrane on both tonsils, culture negative. Swollen glands in neck.
" 9	10	103	75	28,000	.....	84.5	13.25	2	0	0.25	Stomatitis.
" 13	14	101	65	18,300	4,216,000	77	22	0.75	0.25	0	Slight improvement.
" 17	18	99.5	..	7,300	.....	60	35.50	3.25	0	1.25	Marked improvement; herpes labialis.
" 21	22	98.5	65	12,900	.....	58.25	36.75	3.75	0	1.25	Seropurulent discharge from ear; heart action irregular; soft systolic murmur of apex; marked desquamation.
" 25	26	100.4	60	10,500	3,370,000	75.75	19.75	3.25	0.25	1	Fever 102° yesterday.
" 28	29	101.8	..	6,800	.....	64.75	34.75	0	0	0.50	Coryza, cough, conjunctivitis. Many Koplik spots.
" 29	30	102.5	..	5,400	.....	63	35	1.75	0	0.25	Typical eruption of measles on skin and hard palate.
" 31	32	101.6	..	5,900	.....	33.25	63.75	3.0	0	0	Brilliant rash yesterday.
June 2	34	100.8	..	11,800	.....	47.25	54	1.75	0	0	Rash fading.
" 5	37	99.3	..	12,000	.....	56.25	40.75	2.25	0	0.50	
" 9	41	99.1	60	17,600	4,528,000	75	21.75	3	0	0.25	No evident cause for leucocytosis.
" 13	45	99.7	..	13,100	.....	42.25	53.25	4	0	0.50	Slight discharge from ear; sitting up.
" 18	50	98.7	65	12,300	.....	69.25	26.75	3	.25	0.75	Otorrhea continued until June 30. Discharged well July 4.

CASE 2.

SCARLATINA.

Female, 5 years. Entered May 7. Measles one year ago. Onset May 5, with fever and nausea.

Physical examination: Well developed and nourished; moderate prostration. Throat red, without exudate; papillae of tongue enlarged; rash on hard palate; bright punctate erythema over body. Soft systolic at apex. Urine: May 7-11, no albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 7	3	102	85	26,000	4,716,000	88	9.2	2.4	0.4	0	
" 10	6	99.6	80	13,900	.....	57	30.50	12	0.25	0.25	Very mild symptoms; beginning desquamation.
" 13	9	98.5	80	14,200	.....	53.25	34.25	11.75	0	0.75	Desquamation profuse.
" 17	13	98.5	80	16,100	.....	54.75	32.25	11.75	0	0.25	
" 20	16	98.7	90	12,400	.....	64	29	6.75	0	0.25	Heart irregular; soft systolic murmur.
" 25	21	99.7	85	9,000	5,056,000	51.25	42.25	6.50	0	0	Desquamation continues.
June 1	28	99	80	19,700	.....	60	29.75	9	0.25	1	Severe eczema about and inside nose; culture negative.
" 5	32	98.9	..	19,100	.....	53.75	36	6.25	3.75	0.25	Eczema nearly healed.
" 9	36	98.7	..	14,100	.....	.....	.....	.....	.....	.....
" 14	41	.....	80	18,800	.....	65	30.75	3.25	0	0	Still desquamating.
" 18	45	.....	85	15,000	.....	61	32	7	0	0	Nasal discharge ceased.
" 26	53	.....	..	12,000	.....	52	41.25	6	0	0.75	Culture negative; discharged well.

CASE 3.
SCARLATINA.

Female, 2½ years. Entered May 8. Past history negative. Present illness began May 7 with vomiting, fever, and rash.

Physical examination: Well developed and nourished; but little prostration. Throat red; exudate on both tonsils; papillae enlarged. Brilliant punctate eruption on body and roof of mouth, typical of scarlatina. Heart normal. Urine: May 9, no albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 9	3	100	100	44,000	4,900,000	89	9.4	1.4	0.2	0	Brilliant rash.
" 12	6	98.8	85	21,000	.....	62.2	31.6	0	0	0.2	Mild course; rash fading.
" 15	9	98.6	85	25,000	.....	63	34	0	0	1	Desquamation began on 13th.
" 18	12	98.8	75	19,400	4,896,000	64	30.75	5	0	0.25	Desquamation general.
" 21	15	98.5	..	23,700	.....	55.25	41.75	3	0	0	Doing well.
" 25	19	98.8	80	22,100	.....	66	28	5	0.25	0.75	
" 30	24	....	75	23,900	.....	48.75	26.75	0.25	0	0.25	Small "run-around" on thumb of five days' duration; a second on the 31st.
June 5	30	....	..	34,000	.....	48.75	44.25	6.25	0	0.75	Paronychia improving.
" 11	36	....	..	79,500	.....	22.75	75.00	2.25	0	0	Nothing to account for leucocytosis.
" 18	43	....	75	46,900	.....	31	60.75	4.75	3.25	0.25	Spleen palpable; liver and lymph nodes not enlarged.
" 24	49	....	85	21,600	5,292,000	46.75	51.25	1.75	0	0.25	Discharged well, June 26.

CASE 4.
RELAPSE AFTER SCARLATINA.

Boy, 7 years. Entered March 25. Measles last year; pertussis in January, 1902. Entered March 25 for diphtheria which began March 16 with vomiting, fever and sore throat. Four days later noted that tongue was very red, and the papillae enlarged.

Present illness: April 21 transferred to scarlatina pavilion, with typical desquamation of scarlatina on trunk, legs and feet. May 9, temperature 100°. May 10, bright punctate eruption on skin and roof of mouth, papillae red and swollen; throat red. Systolic murmur at apex. Temperature 100°. No vomiting. Urine: April 21 and 28, May 21 and 26: No albumin. Profuse desquamation.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 11	3	100.2	65	21,000	5,112,000	80.25	11	8.75	0	0	Brilliant rash; slight prostration.
" 14	6	99.5	70	16,000	.....	57.25	39.25	3.50	0	0	Euphoria; rash nearly gone.
" 17	9	98.3	70	18,600	.....	59.75	32.25	7	0	1	Rash gone; throat clear.
" 20	12	98.4	80	12,600	5,452,000	63.25	28.75	6.75	0	1.25	Fresh desquamation due to recrudescence.
" 25	17	98.6	..	19,400	.....	78.75	19.75	0	0.25	1.25	Vomiting for past two days; throat and urine negative.
" 28	20	98.2	..	11,700	.....	45.25	52.75	1	0	1	Occasional vomiting; desquamation general.
June 1	24	.....	75	19,600	.....	61	33.75	5.25	0	0	Still desquamating.
" 4	27	.....	..	10,300	.....	18	74.75	6.25	0	1	
" 9	32	.....	..	16,700	.....	69	22	6.25	0.25	2.50	Desquamation nearly gone.
" 12	35	.....	..	18,500	.....	67.25	55	6.75	0	1	
" 17	40	.....	..	17,300	.....	54.75	39.75	4	0	1.75	Desquamation complete.
" 24	47	.....	70	13,300	.....	50.75	44.25	4	0.25	.75	
" 29	52	.....	..	11,600	.....	49.75	40	5	5.75	0	Discharged well June 30.

CASE 5.

SCARLATINA; ENDOCARDITIS; DIPHtheria.

A sailor, 18 years. Entered May 12, 1902. Measles last summer. Present illness began May 11, with diarrhea, headache and sore throat; fever and rash noticed on following day, the latter first appearing on chest.

Physical examination, May 12: Well developed and nourished; marked prostration. Throat red; tongue thickly coated with enlarged papillae; tonsils swollen with exudate, which also covers the posterior pharyngeal wall; brilliant, punctate eruption on body and roof of mouth. Loud systolic murmur at apex; cardiac dullness normal. Temperature 104°. Urine, May 13: trace albumin, no casts; June 5, very slight trace; June 21, none.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 12	2	104	100	17,200	5,208,000	95.25	4.75	0	0	0	
" 14	4	103.4	..	13,600	.....	93.25	5.25	.50	1	0	Very sick; brilliant rash, confluent on thighs.
" 16	6	102.2	90	7,500	.....	79.25	19.75	1	0	0	Rash persists; throat and mouth in bad condition; delirium.
" 18	8	102.1	90	13,200	.....	84.75	14.75	.25	0	0.25	Purulent discharge from nose; membranes coughed up; no diphtheria bacilli but many streptococci in culture.
" 20	10	101.8	..	11,800	.....	.....	.....	.....	.....	.....	Stupor; yellowish membrane on left tonsil.
" 22	12	103.3	95	14,400	4,525,000	81	17.75	.25	0	1	Heart enlarged; loud systolic murmur at apex.
" 25	15	103.1	..	10,100	.....	81	17.75	1.25	0	0	Otitis media purulenta; diphtheria bacilli in throat culture.
" 28	18	98.6	..	.....	.....	63	34.75	1.25	0.25	.75	Temperature normal; a general improvement; profuse desquamation.
" 30	20	98.5	75	13,300	.....	64.25	33.75	.25	0	1 75	Heart same; bacilli still present.
June 5	26	98.2	..	10,300	.....	66.75	31.75	.25	0	1.25	Cardiac dullness diminished; sounds of better quality; marked improvement.
" 13	34	98.6	80	7,600	4,448,000	72.75	23.75	2.25	0	1.25	Heart much enlarged; loud blowing systolic murmur at apex and in axilla; accentuated pulmonary second sound. Discharged July 18.

CASE 6.

SCARLATINA.

Girl, 7 years. Entered May 14. Diphtheria, varicella, and pertussis previously. Present illness began May 11, with vomiting, fever and angina.

Physical examination, May 14: Well developed and nourished; moderate prostration. Throat red with some exudate on tonsils; papillae much increased in size; punctate erythema on roof of mouth and over body, emphasized in groins and axillae. Slight systolic murmur. Urine: no albumin. Temperature 103.5°.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 15	5	101	80	16,900	4,932,000	62	12	.26	0	0	Very mild case; bright rash.
" 17	7	98.7	..	12,600	.....	35.75	61.75	1.25	.25	1	Rash nearly gone; beginning desquamation.
" 20	10	98	..	13,100	.....	49.5	47	3.5	0	0	General desquamation.
" 25	15	100	..	23,400	.....	67.25	26.25	6.50	0	0	Convalescence.
" 28	18	98.8	..	15,500	.....	65.50	29.25	3.25	0	2	Herpes labialis.
" 31	21	98.5	80	16,300	.....	66.25	29.75	3.75	.25	..	
June 5	26	.....	..	8,900	.....	37	53.75	6	2.25	1	Paronychia on two fingers; vaccination June 6.
" 10	31	.....	..	10,700	.....	76	20	3.50	0	.50	Still some desquamation.
" 12	33	103.5	..	8,900	.....	54.25	43.50	2	.25	..	Temperature probably due to vaccination.
" 18	39	.....	70	9,800	5,044,000	24	62	12	0	2	Discharged well, July 21.

CASE 7.

SCARLATINA; DIPHTHERIA.

Girl, 4 years. Entered May 17. Diphtheria two years ago. Present illness began May 15, with sore throat and vomiting; rash appeared on the 17th.

Physical examination: Well developed and nourished; general condition good, "strawberry" tongue; throat red; exudate at mouths of crypts on tonsils; faint punctate erythema on roof of mouth, abdomen and extremities, emphasized in axillae and groins. Enlarged lymph nodes in right side of neck. Paronychia of some duration on finger, with loss of nail; superficial impetiginous lesion of foot. Heart normal. Urine: May 15, no albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 17	3	101	80	21,000	4,508,000	88.50	11.25	0	0	0.25	
" 19	5	.....	..	.....	.....	82.25	14	2.75	1	0	Rash bright on thighs, fading elsewhere.
" 20	6	100.8	60	25,900	.....	62	31.50	6.25	0	0.25	Beginning desquamation.
" 23	9	100	..	15,400	.....	60	40	0	0	0	Patient sitting up.
" 27	13	99.6	60	12,800	4,204,000	69.75	28.25	2	0	0	
" 31	17	98.4	..	9,100	.....	70.75	27.25	1.50	0.25	0.25	
June 7	24	99.2	..	13,200	.....	53.50	46.25	0	0	0.25	Patient about the ward.
" 16	33	98.5	70	12,100	4,868,000	58	37	5	0	0	
" 22	39	102.9	..	.....	.....	.....	.....	.....	.....	.....	Membrane on tonsils; culture shows diphtheria bacilli.
" 28	45	98	..	21,600	.....	84	16	0	0	0	Throat clear on 24th; anti-toxin urticaria. Discharged well July 11.

CASE 8.

SCARLATINA.

Girl, 2½ years. Entered hospital May 16. Past history negative. Present illness: Onset, May 14, with sore throat and vomiting.

Physical examination: Rachitic rosary; considerable prostration. Throat and tongue red, papillae much enlarged; bright red punctate erythema on roof of mouth and thickly over body, especially in axillae and groins. Systolic murmur at apex. Temperature 103.2°. Urine: May 17, slight trace albumin; May 24, slightest possible trace; June 11, trace albumin; hyaline and granular casts, normal blood and renal cells.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 18	5	101.3	65	16,600	3,749,000	54.25	39.25	6.50	0	0	Rash still bright.
" 20	7	100.8	..	28,300	.....	60	36	2.75	0.25	1	Rash fading; desquamation beginning on neck and arms; cervical lymph nodes swollen.
" 21	8	100.8	..	34,600	.....	75	23	1.75	0.25	0	Patient improving.
" 23	10	100	..	25,800	.....	70	25	1.50	0.50	0	Typical desquamation; lips swollen and bleeding.
" 27	14	98.8	65	20,300	4,412,000	67.25	29	3.50	0	0.25	
" 31	18	98.7	60	15,200	.....	.....	.....	.....	.....	.....
June 6	24	102.2	..	26,400	.....	62.75	35.75	0.75	0.25	0.50	Intermittent fever of unknown cause.
" 14	28	101	..	21,600	.....	72.50	24.50	1	1.75	0.25	Double otitis media with profuse purulent discharge; cervical adenitis.
" 22	36	100	55	11,200	4,744,000	53	43.50	1.25	1	1.25	Paronychia.
" 29	43	....	65	11,400	.....	41.75	57.75	0.50	0	0	Grad. improvement; aural discharges ceased. Discharged well July 25.

CASE 9.

SCARLATINA, NEPHRITIS, DIPHTHERIA.

Boy, 5 years. Entered May 19. Past history: measles and pertussis. Present illness Onset, May 17, with vomiting, fever and rash.

Physical examination: Well developed and nourished; only moderate prostration. Mouth and throat red; papillae hypertrophied; no exudate; fading punctate erythema on chest, abdomen and thighs, also on hard palate. Heart normal. Temperature 101.3°. Urine: May 20, no albumin.

Date	Day	Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 19	3		101.3	85	23,100	4,720,000	....	....	....	....	....
" 21	5		100	..	18,100	.....	72	23.25	3.75	0.25	0.75	Profuse rash on thighs, fading elsewhere.
" 23	7		99.5	80	21,500	.....	67.75	27.25	3.25	1.75	0	Beginning desquamation; euphoria; systolic murmur at apex.
" 27	11		98.8	..	16,800	.....	66.25	31.25	1.75	0.75	0	Typical desquamation.
" 30	14		100	..	27,300	.....	75.25	30	3.50	0.75	0.50	
June 3	18		100.8	..	17,500	.....	67.50	29	3.25	0	0.25	Cervical lymph nodes much enlarged.
" 8	23		98.8	..	20,800	.....	72.50	26.25	1.25	0	0	Face puffy; vomiting; urine of acute nephritis.
" 11	26		98.8	..	25,900	.....	74.25	21.25	3.75	0	0.75	Marked symptoms nephritis; urine as on 8th.
" 14	29		98.7	55	22,500	4,506,000	68	27.25	4	0.25	0.50	Some improvement.
" 18	33		98.6	..	19,600	.....	58.25	37	4.25	0	0.50	Systolic murmur at apex.
" 23	38		98.4	60	19,400	.....	59	39	2	0	0	Gaining steadily; only trace albumin.
" 27	42		....	60	17,800	4,515,000	41	55	3.25	0.25	0.50	
July 2	47		....	..	13,900	.....	44.50	50.50	5	0	0	
" 7	52		....	60	12,100	.....	46.75	49.75	3.25	0.25	0	Patient up.
" 14	59		101.7	50	16,100	.....	60	39.25	0.75	0	0	Slight relapse of nephritis.
" 17	62		99	60	10,600	4,632,000	56	42	3	0	0	
" 19	64		103.1	..	14,500	.....	58.25	39.75	1.50	0.50	0	Membrane on left tonsil; diphtheria bacilli present.
" 22	67		98.5	..	13,700	.....	63.50	34	2	0.50	0	
" 26	72		....	..	12,800	.....	52	46.75	0.75	0.25	0.25	Still some symptoms of nephritis; throat clean. Discharged Aug. 2.

CASE 10.

SCARLATINA, DIPHTHERIA.

Colored girl of 6 years. Entered May 19. No history obtainable.

Physical examination: Well developed and nourished; does not appear sick. Throat negative; tonsils slightly swollen; papillae red and prominent; no skin eruption; typical flaky desquamation on knees, elbows and hands, finer on trunk. Judging from the desquamation, the disease is of about two weeks duration. Heart irregular, not enlarged; soft systolic murmur at apex; pulmonic second sound slightly attenuated; occasional sibilant râle. Temperature 98.5°. Urine: May 19, no albumin; May 24 and June 24, slightest possible trace.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 19	14	98.5	..	13,400	.....	44	54.25	1.75	0.75	0.25	Convalescence; slight bronchitis.
" 22	17	98.3	..	20,200	.....	50.25	47.75	2	0	0	
" 25	20	98.5	..	20,400	.....	50.75	48	0.75	0.25	0.25	
" 28	23	....	70	13,600	4,824,000	60	26.25	13.75	0	0	Severe bronchitis. Cough improving. Sore throat; membrane on tonsils; cervical nodes enlarged.
June 1	27	....	..	14,000	.....	60.50	37.50	1.75	0	0.25	
" 6	32	....	..	7,600	.....	47	50.50	2.50	0	0	
" 10	36	103.3	..	.....	.....	....	....	....	....	....	Sore throat; membrane on tonsils; cervical nodes enlarged. Diphtheria bacilli found in nasal secretions and throat.
" 12	38	98.5	50	15,200	.....	56.50	40.75	1.75	0	1	Throat clean; desquamation.
" 16	42	98.5	60	16,700	4,200,000	65.75	33.25	1	0	0	Antitoxin urticaria; temperature normal on the 23d.
" 21	47	103	65	9,400	.....	67.25	29.75	2	0	1	A few râles; systolic murmur probably functional. Discharged well July 2.
" 28	54	....	50	12,900	3,818,000	61.50	36	1.50	0	1	

CASE 11.

SCARLATINA.

Colored boy of 3 years. Entered May 20, 1902. Measles six months ago. Present illness: Onset, May 19, with fever and sore throat.

Physical examination: Well developed and nourished; condition good. Fauces red, without exudate; papillae of tongue enlarged and red; punctate eruption on roof of mouth; discrete eruption over whole body, the swollen mouths of the hair follicles showing up plainly on the black skin. Heart negative; a few coarse râles. Urine: No albumin on repeated examination.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 20	2	100.4	..	11,800	83	14.75	2.25	0	0	Mild Case. Rash fading. Desquamation. Doing well.
" 22	4	99.5	75	12,100	4,396,000	79.50	17.50	2.50	0	0.50	
" 25	7	101.5	..	19,700	.....	80.25	18	1.75	0	0
" 28	10	101.3	..	18,100	70	27.50	2.25	0	0.25	Good convalescence. Discharged well July 10.
" 31	13	98.2	85	16,500	.....	68.75	26.25	2	0	1
June 3	16	100	..	9,300	.....	....	....	....	....	....
" 8	21	79.2	..	12,500	54	42.50	1.50	0.75	1.25	
" 17	30	98.5	60	8,400	5,292,000	61.75	34	3.50	0	0.75	

CASE 12.

SCARLATINA.

Boy, 7 years. Entered May 21. Past history: Measles and diphtheria previously. Present illness began May 7, with rash.

Physical examination: Well developed and nourished. Glands in neck much enlarged; throat negative; papillae swollen; no eruption; skin rough with "breaks" at fingers and toes. Slight systolic murmur at apex. Temperature 99.4°. Urine: no albumin May 22; May 30, slightest possible trace; June 4, slight trace with few granular and epithelial casts, some with blood adherent; small and large round cells. June 16, only slightest possible trace albumin

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 21	15	99.4	..	16,200	.....	78.50	17.75	3	0.25	0.50	
" 23	17	99.8	60	13,100	4,124,000	52	38.50	7.50	0	2.00	
" 27	21	98.8	..	12,600	.....	46.50	45.50	7.25	0	0.75	Slight desquamation. Inconstant systolic murmur at apex with accentuation of pulmonary second sound; no increase in area cardiac dullness.
June 1	26	98.6	..	13,700	.....	54.25	41.75	4	0	0	
" 3	28	104.2	..	35,500	.....	87.50	10.75	0	1	0.75	Temperature probably due to adenitis.
" 6	31	98.3	..	11,600	.....	61.25	33.50	5	0	0.25	
" 10	35	100	..	15,800	.....	40.50	53	6	0	0.50	
" 15	41	99.4	60	11,300	4,676,000	68	25	5.50	0.25	0.25	
" 22	47	100	60	12,800	.....	43.25	49.75	6	0.25	0.75	Alveolar abscess. Discharged well, July 11.

CASE 13.

SCARLATINA.

Boy, 2½ years. Past history: Measles. Present illness: began May 20, with rash.

Physical examination, May 21: Well developed and nourished, only little prostration. Slight nasal discharge; papillae of tongue enlarged and red; throat somewhat reddened; no rash on roof of mouth; punctate erythema all over body; bright on thighs and lower abdomen, fading elsewhere. Soft systolic murmur at apex; heart otherwise normal. Temperature 99.9°. Urine: no albumin May 23 and 24.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 21	2	99.9	..	12,200	.....	75.25	20.75	4	0	0	
" 24	5	101.7	65	15,000	4,580,000	45.50	53.50	0.75	0	0.25	Mild course, temperature normal on the 25th.
" 27	8	98	..	11,500	.....	67	32	1	0	0	
" 30	11	98	80	14,200	.....	52.50	45.25	1.75	0	0.50	Doing well.
June 5	17	....	..	11,700	.....	50	46	4	0	0	Typical desquamation on hands; slight discharge from ear.
" 11	23	....	..	16,400	.....	64	35.25	0.50	0	0.25	Vaccination.
" 14	26	98.7	80	11,200	.....	63.75	35	0.25	0.75	0.25	Temperature 103.3° on the 12th, due to blocking up of pus in ear.
" 18	30	100	..	14,500	.....	55.50	42	2.50	0	0	Reaction from vaccination.
" 27	39	99	85	14,600	4,936,000	58.25	39	2.75	0	0	Considerable inflammation at seat of vaccination Discharged well, July 14.

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CASE 14.

SCARLATINA.

Girl, 13 years. Measles at age of 5, pertussis at 8. Present illness: Onset May 19 with slight sore throat, fever and headache accompanied by an eruption on the body. Only mild symptoms: no prostration.

Physical examination May 23: Well developed and nourished. Throat red; no exudate; papillae of tongue enlarged; enlarged lymph nodes in neck: punctate erythema on roof of mouth, trunk and extremities. Soft systolic murmur at apex, not transmitted; heart otherwise normal. Urine: May 23 and July 5, no albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mononuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 23	5	99.6	80	12,200	5,088,000	65.75	23	11.25	0	0	
" 25	7	98.7	..	12,100	.....	46.75	43.25	9	1	0	Rash gone; beginning desquamation.
" 27	9	98.3	..	14,300	.....	50.50	43	6.55	0	0.25	Very mild case; pronounced desquamation.
" 29	11	98.4	..	13,200	.....	42.50	47.25	9.75	0	0.50	
June 1	14	98.4	80	16,000	.....	62.25	33	3.75	1	0	Typical desquamation.
" 3	16	98.8	..	20,900	.....	40.50	52	5	0	2.50	Convalescence.
" 6	19	98.5	..	18,600	.....	48	46.25	4	0.75	1	Up on the 8th.
" 10	23	....	..	11,800	.....	49	45.25	5.75	0	0	
" 14	27	....	80	10,800	.....	48.50	44.25	6.50	0	0.75	
" 19	32	....	80	15,300	5,364,000	39.25	50.75	9	0	1	Nothing objective to account for leucocytosis.
" 23	36	....	..	18,800	.....	61	28.50	9.25	0	1.25	
" 27	40	....	..	13,800	.....	52.75	39.75	6	0	1.50	
July 1	44	....	80	16,400	.....	60	34	5.75	0.25	0	
" 5	48	....	..	11,800	.....	40.50	54	4.50	0	1	
" 9	52	....	85	11,400	.....	37.25	52.25	9	0	1.50	Discharged well, July 12.

CASE 15.

SCARLATINA.

Girl, 10 years. Past history: varicella, pertussis and measles. Present illness: Onset May 25, with sore throat, vomiting, headache and rash.

Physical examination May 27: Well developed child; much prostration; tender, enlarged lymph nodes in both sides of neck; throat red, with exudate on tonsils; papillae enlarged and red; brilliant punctate eruption on roof of mouth and well over body, with much erythema. Soft systolic murmur, pulmonary second sound accentuated; heart not enlarged. Urine: May 28 and June 2, no albumin. Temperature, 103°.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mononuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 27	3	103	..	15,800	.....	75.75	24.25	0	0	0	
" 29	5	102.7	..	13,600	.....	57.50	41.50	0.25	0.75	0	Very sick; brilliant rash. Improving.
" 31	7	100	..	17,200	.....	57	36	6.25	0.75	0	
June 3	10	98.4	..	16,300	.....	57	40.50	1.50	1	0	Eruption fading on the 1st
" 6	13	98.5	..	13,600	.....	86.50	12.50	1	0	0	Typical desquamation; deafness.
" 9	16	98.5	..	15,200	.....	70.75	27.25	0.50	0.50	0	Profuse desquamation; no otitis media.
" 13	20	....	..	10,900	.....	50	46	2.50	0.50	1	General condition good.
" 18	25	....	65	17,000	4,160,000	60	35.25	3.50	1	0.25	
" 22	29	....	60	13,500	.....	46	51.75	1	0	1.25	Feet and hands still desquamating.
" 26	33	....	..	17,400	.....	60	36	3.25	0	0.75	Up about ward.
" 29	36	....	65	15,400	4,128,000	55	42.25	2.75	0	0	Desquamation complete, except feet.
July 3	40	....	..	14,400	.....	51	47.25	2.75	0	0	
" 8	45	....	65	14,200	4,214,000	70	26.75	2	0	1.25	
" 15	52	....	60	15,500	4,486,000	59	33.50	6.75	0.50	0.25	Discharged well, July 18.

CASE 16.

SCARLATINA WITH PERITONSILLAR ABSCESS.

Woman, 20 years old. Measles six years ago. Present illness began May 28, with sore throat, headache, vomiting, chill, fever and general prostration.

Physical examination, May 29. Well developed and nourished; considerable prostration. Coryza; throat red; tonsils swollen, with exudate; papillae of the tongue enlarged; punctate eruption on roof of mouth; enlarged tender lymph nodes of neck. Typical punctate erythema over body. Heart enlarged 1 cm. to left of nipple line; loud systolic murmur heard all over the precordia, in the axilla and back. Pulmonic second sound not accentuated. Urine: no albumin. Throat cultures negative, May 28.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 29	2	101.7	..	30,000	.....	96.25	3.75	0	0	0	Bulging in front left tonsil Copious discharge pus from abscess of tonsil.
" 31	4	100	..	18,700	.....	95.25	4.75	0	0	0	
June 3	7	98.5	..	14,000	.....	73	23.50	3	0	.50	Condition good.
" 6	10	98.5	..	15,200	.....	57	40.50	1.50	1	1	
" 9	13	98.5	..	14,600	.....	83.50	15.50	1	0	0	Typical desquamating. Up
" 14	18	....	..	9,800	.....	67.25	24	8	.75	0	
" 19	23	....	85	10,200	5,395,000	....	....	....	....	....	Feet still desquamating.
" 26	30	....	80	11,300	.....	57.50	40	.50	1	1	

CASE 17.

SCARLATINA.

Girl, 3 years old. Present illness began May 28, with sore throat and fever.

Physical examination, May 29. Moderate prostration; considerable nasal discharge; throat red; exudate on tonsils; papillae of tongue enlarged; typical punctate erythema over body. Systolic murmur at apex. Enlarged tender cervical lymph nodes. Urine: no albumin, May 30. Cultures from throat and nose negative, May 29 and 30, June 5, 21 and 22.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 30	3	101.4	70	31,800	4,908,000	72	28	0	0	0	Rash bright on legs, fading elsewhere; thick yellow exudate on tonsils.
June 1	5	101.4	..	32,300	.....	73.25	26.25	0.50	0	0	
" 4	8	99	..	29,200	.....	60	36	1.75	1.75	0.75	Throat improving. Throat and tonsils free from exudate.
" 7	11	98.5	..	47,200	.....	74.50	22.50	2	1	0	
" 11	15	98.4	..	26,500	.....	75.50	24	0.50	0	0	Desquamation; throat negative.
" 15	19	98.2	..	9,300	.....	42.75	55.25	2	0	0	
" 21	25	98.7	65	24,600	4,348,000	51.25	44.25	4.50	0	0	Antitoxin rash. Doing well; Temperature 101.4° on the 16th.
" 26	30	98.2	65	24,600	.....	58.50	37.50	3	1	0	
July 3	37	....	60	17,000	.....	40.75	57.25	1	0	1	Still desquamating.
" 10	44	....	65	17,600	.....	35.75	63.75	0.50	0	0	
" 18	52	....	75	19,500	5,027,000	41	56.75	1.75	0	0.50	Irregular heart; systolic murmur at apex.
" 25	59	....	..	19,400	.....	42	55	1.25	0	1.75	

Discharged well, July 28.

CASE 18.

SCARLATINA.

Boy, 3½ years. Entered May 29. Present illness: Pertussis for some weeks, still whoops.

Physical examination: Robust child; much prostration. Profuse coryza; throat red but no exudate; strawberry tongue; rash on roof of mouth; brilliant punctate erythema all over body; brightest on legs, fading on trunk. Systolic murmur at apex; heart not enlarged. A few fine moist râles (pertussis). Whoops occasionally.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 30	9	102.2	..	28,900	.....	66	33.50	0.50	0	0	
June 1	11	100.8	..	31,900	.....	77.75	19.	1	2.25	0	
" 4	14	102	..	27,500	.....	67.	30.25	2	0	0.75	Considerable nasal discharge.
" 7	17	98.8	..	26,700	.....	74.50	23.50	1.75	0	0.25	Desquamation beginning; throat negative; vaccination on the 6th.
" 16	26	98.5	..	12,700	.....	60.25	37.25	1.50	0	1	Typical desquamation; cervical lymph nodes enlarged.
" 22	32	....	60	21,700	4,008,000	50	44.25	3.50	2	0.25	Nothing to account for leucocytosis.
" 25	35	....	..	16,900	.....	.....	.....	.....	....	....
" 29	39	....	55	17,000	.....	52.25	45.25	2.25	0	0.25	
July 8	48	....	65	15,200	.....	54.50	44.50	1	0	0	
" 14	54	....	65	11,900	.....	65	34	1	0	0	Discharged well July 19.

CASE 19.

SCARLATINA.

Boy, 7 years. On May 22 is said to have had macular eruption on hands and wrists; preceded by cough and sore eyes for several days (measles?). On May 28, scarlet rash came out on body.

Physical examination, May 30: Vigorous; moderate prostration. Eyes suffused, conjunctivae congested; throat red but no exudate; papillae of tongue swollen; punctate eruption on roof of mouth; on trunk, legs and arms, fading punctate rash characteristic of scarlatina; branny desquamation on face. Systolic murmur at apex; no râles. Temperature 100°. Urine: No albumin June 2, 14 and 23.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 30	3	100	..	11,400	.....	58	38.75	3.25	0	0	
June 1	5	98.7	..	15,200	.....	57.25	39.25	2.50	0.25	0.75	Temperature 104° June 2; enlarged tender lymph nodes in neck.
" 4	8	101.1	..	20,600	.....	77.75	20.25	0.75	0	1.25	
" 7	11	98.9	..	25,700	.....	75.50	24.50	0	0	0	Discharge from right ear.
" 10	14	98.6	..	12,100	.....	61.50	35	2.50	0	1	Faint systolic murmur at apex.
" 16	20	99.5	..	13,100	.....	.....	.....	.....	....	....	Fresh swelling of glands of neck; right ear still discharging.
" 22	26	102.7	..	15,000	.....	70.25	25.25	4	0	0.50	Temperature apparently due to enlarged lymph nodes.
" 27	31	98.5	65	12,200	4,148,000	61	31	7.75	0	0.25	
July 7	41	98.8	60	12,600	4,797,000	54.25	40	2.50	0	3.25	Discharged well July 22.

CASE 20.

SCARLATINA WITH NEPHRITIS.

Boy, 5 years. Two sisters ill with scarlatina. Present illness began May 10, with rash.

Physical examinations May 30: Healthy child; pronounced desquamation, typical of scarlatina, on hands and legs, slightly on back; papillae of tongue enlarged; chronic enlargement of tonsils; enlarged lymph nodes behind the left ear. Heart slightly irregular, sounds normal. No edema. Temperature 101.1°. Urine: May 31; large trace of albumin; smoky; contains casts and blood.

Date	Day	Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclear	Mononuclear	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 30	21		101.1	..	23,100	.....	78.25	19.75	1	0	1	
June 1	23		99	..	16,800	.....	63.50	34.50	2	0	0	
" 5	27		101	..	14,900	.....	73.	25.50	.50	0	1	Trace of albumin in urine.
" 8	30		99	..	9,600	.....	52.75	43.50	1	1.75	1	Lymph nodes in neck enlarged; systolic murmur over precordia.
" 11	33		98	..	12,400	.....	50.50	48	1.25	0	.25	Trace albumin in urine.
" 17	39		98.8	55	16,200	.....	52.25	43.25	4.50	0	0	Still desquamating.
" 21	43		98.5	..	22,700	.....	87.	12.	.25	0	.75	Temperature 105° last night, probably due to enlarged glands in neck.
" 24	46		99	55	13,100	3,603,000	51.25	46.75	2	0	0	Marked improvement.
" 27	49		102.5	..	18,500	.....	77.75	22	0	0	.25	General condition better, but glands in neck again enlarged.
July 2	54		98.8	..	9,300	.....	52.50	44.50	2.25	0	.75	Some achromia and poikilocytosis; no nucleated red cells.
" 6	58		....	55	10,400	3,811,000	40.50	53.50	5	0	1	Discharged well July 8.

CASE 21.

SCARLATINA, BRONCHOPNEUMONIA.

Boy, 1½ years. Measles six months ago. Present illness began May 20 with sore throat, fever and vomiting. Rash appeared three days later. History of exposure to scarlatina.

Physical examination May 30: Strong appearing child; extreme prostration. Cyanosis; some retraction of lower ribs with respiration; tracheal râles; large tender lymph nodes on both sides of neck; profuse nasal discharge; pharynx red with exudate on posterior wall; tonsils clear; papillae on tongue enlarged; no rash; no desquamation. Heart action weak; systolic murmur. Lungs full of râles, with patches of bronchial breathing in right axilla and back. Spleen palpable. Cultures of throat negative. Temperature 102°. Antitoxin, 8000 units.

Blood examination, May 30 (11th day of disease), Hemoglobin 65%; Leucocytes 23,900 per c. mm.; differential count—polynuclears 73.25%; mononuclear 26%; eosinophiles .5%; myelocytes .25%; slight achromia and poikilocytosis.

No improvement with stimulation, death at 4 p. m., May 31. No autopsy.

Examination on 31st showed dullness with bronchial breathing below the angle of the scapula on the right and patches of bronchial breathing in the left lung.

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CASE 22.

SCARLATINA.

Boy, 5 years. Measles four years ago, pertussis a year later. Present illness: Onset June 2, with headache, cough and fever.

Physical examination, June 6: Well developed boy; moderate prostration; nasal discharge; throat red with membrane on tonsils and uvula; papillae of tongue red and swollen; punctate erythema on roof of mouth and brilliant over body; cervical lymph nodes enlarged. Systolic murmur at apex. Temperature 103.8° Urine: No albumin June 6 and 13.

Date	Day Disease	Temperature	Hemaglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclear	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 7	6	99.3	..	27,800	.....	65	28	6	.75	.25	Severe adenitis; throat culture negative.
"	9	98.7	..	26,900	.....	65.75	32.75	.25	.25	1	Throat better; typical desquamation beginning.
"	11	98.5	..	23,700	.....	56.50	39	3.50	0	1	Throat clear; heart action irregular; but no murmurs.
"	14	98.5	..	14,500	.....	.....	.....	.....	.....	.....	Doing well; glands no longer enlarged.
"	17	98.6	80	22,100	5,168,000	64	34	1.75	.25	0	Profuse desquamation.
"	21	99.5	..	13,100	.....	50.25	47.25	2	0	.50	Cardiac condition improving.
"	25	98.4	85	12,300	.....	.....	.....	.....	.....	.....
"	29	98.4	..	12,600	.....	50	47.25	2	0	.75	
July 5	34	....	..	14,300	.....	50	45	4	0	1	Still some desquamation. Discharged well Aug. 7.

CASE 23.

SCARLATINA.

Girl, 5 years. Entered hospital June 11. No history obtained.

Physical examination: Robust; slight prostration; throat red, no exudate; papillae enlarged; lymph nodes in neck moderately enlarged; very brilliant punctate erythema on roof of mouth and over body. Soft systolic murmur over precardia. Spleen just palpable. Temperature 103.8° Urine: No albumin, June 11.

Date	Day Disease	Temperature	Hemaglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 11	3	103.8	..	13,800	.....	55	41.25	2.25	.75	.75	Brilliant rash; throat very red but without exudate; enlarged cervical lymph nodes.
" 13	5	104.1	80	16,400	5,152,000	87.25	11.75	1	0	0	
" 15	7	100	..	29,300	.....	64.50	30.50	4	1	0	
" 17	9	100	..	34,000	.....	56.75	40.75	2.50	0	0	Rash fading.
" 20	12	99.7	70	16,200	.....	59	34.25	5	1	.75	Desquamation began yesterday.
" 23	15	98.5	70	18,600	5,280,000	54.50	42.50	2	0	1	Extensive desquamation; condition good.
" 27	19	98.5	..	13,000	.....	47.25	47	3.50	1	1.25	Patient up.
" 30	22	98.9	..	11,600	.....	49.75	43	4	1	2.25	
July 5	27	....	60	13,700	.....	28	64	7.25	.25	.50	Still considerable desquamation.
" 8	30	....	60	24,100	5,260,000	54.50	40.50	4	0	1	No explanation of high white count.
" 12	34	....	..	12,600	.....	52	46	1.25	0	.75	
" 17	39	....	70	18,000	.....	53	46.25	.25	.50	0	Systolic murmur heard at base.
" 21	43	....	..	12,600	.....	41.50	56	2	0	.5	
" 25	47	....	65	16,600	.....	55.50	41	3.50	0	0	
" 30	52	....	..	11,900	.....	47	50.25	2.50	0	.25	Discharged well July 31.

CASE 24.

SCARLATINA.

Girl, 6 years. Past history: Pertussis, measles, and varicella. Present illness began June 9, with fever, vomiting, and rash.

Physical examination June 11: Well developed and nourished; no prostration. Tongue thickly coated, with enlarged papillae; throat red, with small amount of exudate on tonsils; lymph nodes in neck not enlarged; moderate punctate eruption on roof of mouth; bright on body (typical of scarlatina), already fading except on legs and back. Systolic murmur at apex. Temperature 101°. Urine: No albumin June 12 and July 8.

Date	Day	Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono- nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 11	3		101.2	75	17,500	5,572,000	77.75	16.25	5.75	0.25	0	
" 13	5		98.8	..	12,600	.....	60	32.75	6.25	0	1	Rash still bright on legs; no exudate in throat.
" 15	7		98.1	..	16,200	.....	45	47.25	4	0.25	2.50	Rash gone; moderate en- largement of lymph glands in neck; des- quamation beginning on chest.
" 17	9		99	75	17,200	.....	65.25	34.75	0	0	0	Desquamation profuse.
" 20	12		98	..	12,600	.....	56.75	40	2	0	1.25	Patient up.
" 23	15		98.1	70	14,700	5,428,000	68.25	29.50	1.25	0	1	
" 27	19		....	..	16,700	.....	46	49.25	4.75	0	0	Still desquamating.
July 1	23		....	70	15,400	.....	48	43	8.75	0	0.25	
" 5	27		....	..	21,000	.....	63.75	32.75	3.50	0	0	No complications.
" 8	30		....	65	18,200	.....	55.25	38.25	5.50	0	1	
" 12	34		....	..	13,700	.....	63.50	31	5	0	0.50	
" 16	38		....	85	18,000	5,651,000	56.50	35	7.50	0	1	Heart action irregular.
" 19	41		....	..	15,200	.....	62	34	3.75	0	0.25	
" 23	45		....	..	9,800	.....	42.50	56.25	1.25	0	0	
" 28	50		....	..	11,200	.....	43	53	3	0	2	Discharged well July 31.

CASE 25.

SCARLATINA, ENDOCARDITIS.

Boy, 7 years. One brother ill at hospital with scarlatina (Case 27). Measles four years ago. Present illness began June 7, with vomiting, headache, and fever.

Physical examination June 10: Well developed and nourished; great prostration; delirious at times. Serous nasal discharge; throat red, with exudate on tonsils; papillae enlarged and red; large tender lymph nodes in neck; typical punctate erythema over body and on hard palate; most intense at flexures of joints and on legs. Heart: rapid, weak, and slightly irregular; enlarged to the left; systolic murmur at apex; pulmonary second sound accentuated. A few râles. Temperature 103.4°. Urine: June 10, slightest possible trace of albumin; June 14, 23, and July 14, no albumin.

Date	Day	Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono- nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 10	4		103.4	..	20,600	.....	94	5	0	1	0	
" 12	6		100.2	80	21,500	4,508,000	88	10.50	1.50	0	0	Delirious.
" 14	8		100	..	18,800	.....	.....	.....	.....	.....	.....	Better; desquamation be- gins.
" 17	11		99	..	23,300	.....	67.75	33.25	1.50	1	1.50	Marked improvement; pronounced desquama- tion.
" 19	13		98.7	..	13,600	.....	60.25	37.75	1	0	0	
" 22	16		98.5	75	13,400	.....	54.25	41.25	1.75	1.75	1	Cardiac dilatation; ac- tion irregular; systolic murmur.
" 26	20		98.6	..	13,300	.....	53.50	42	4.50	0	0	Continued improvement; still desquamating.
" 30	24		98.1	70	10,800	4,380,000	50	44.25	4.75	0	1	
July 5	29		99	..	8,100	.....	34	57.50	8.50	0	0	Serous inflammation of middle ear; paracen- tisis.
" 9	33		99.2	70	8,900	4,564,000	52.55	46.25	0.50	1	0	Slight discharge from ear; Aug. 18, heart still en- larged; somewhat irreg- ular; loud blowing sys- tolic murmur at apex transmitted to axilla. Discharged relieved.

CASE 26.

SCARLATINA

Boy, 6 years. One brother has scarlatina. Present illness began June 11, with vomiting.

Physical examination June 14: Mulatto boy, presenting only slight prostration; typical tongue, red with enlarged papillae; tonsils red and swollen, with a little exudate on back. Lymph nodes in neck enlarged, not tender, punctate eruption over body. Systolic murmur at apex. Urine: June 15, very slight trace of albumin. Temperature 100.2°.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 14	4	100.2	60	20,500	4,430,000	.....	.....	....	....	....	Rash still visible.
" 16	6	98.6	..	16,600	.....	47	50.25	1.75	0.50	0.50	Desquamation begins; rash gone; tonsils enlarged and reddened.
" 18	8	99	..	19,600	.....	59	39.75	1	0.25	0	Extensive desquamation.
" 21	11	99	65	25,000	.....	67	31.75	1.22	0	0	
" 24	14	98.5	65	17,400	4,416,000	58.50	37.50	2.75	1	0.25	Still much desquamation.
" 27	17	98	..	21,000	.....	53.25	45	0.75	0.75	0.25	
" 30	20	99	..	18,900	.....	44.50	50.50	4.75	0	0.25	
July 5	25	....	70	16,800	4,627,000	66.50	31.75	1.75	0	0	Still desquamating; patient improving rapidly.
" 9	29	....	..	16,400	.....	50.75	45	2.75	1	0.50	
" 12	32	....	..	16,100	.....	57	40	2.50	0	0.50	
" 16	36	....	70	19,400	4,688,000	38	60	0.75	0.75	0.50	
" 21	41	....	..	14,500	.....	40.25	58.25	1.50	0	0	
" 26	46	....	75	18,200	4,712,000	48	50.25	1.50	0	0	
" 30	50	....	..	13,700	.....	.....	.....	....	....	....	Discharged well, Aug. 3.

CASE 27.

SCARLATINA, ENDOCARDITIS.

Boy, 6 years (brother to Case 25). Measles four years ago. Present illness began June 9 with vomiting.

Physical examination June 10: Strong boy. Throat red; tonsils enlarged; some exudate; papillae large and red; punctate erythema on roof of mouth and skin, bright on extremities, fading on chest; lymph nodes in neck not enlarged. Heart not hypertrophied; systolic murmur. Urine: No albumin June 11, July 18 and 26.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 10	2	104.6	90	26,200	5,456,000	87.75	11.25	1	0	0	
" 12	4	100.8	..	24,000	.....	78.25	14.	7.75	0	0	Rash fading; conditions improving.
" 14	6	100	..	23,300	.....	68.75	23	8	0.25	0	Rash nearly gone; cervical glands much enlarged.
" 17	9	99.5	..	25,200	.....	79	16.50	4	0.50	0	Desquamation began on the 15th.
" 20	12	98.7	70	17,200	.....	73	24.75	2	0	0.25	Condition good.
" 23	15	98.5	80	20,000	4,949,000	71.50	25.50	2.25	0	0.75	
" 26	18	99	..	15,100	.....	57	39.50	2.75	0	0.75	
" 29	21	98.4	..	13,200	.....	46.75	44.25	7.50	0.25	1.25	Desquamation persists.
July 3	25	99	70	17,500	4,716,000	56.50	40.50	3	0	0	Heart examination, idem.
" 7	29	99	..	12,700	.....	44.75	51	3.75	0	0.50	
" 11	33	102	80	16,700	5,651,000	76.25	21.25	1	0.75	0.75	Follicular tonsilitis.
" 15	37	100.2	..	10,600	.....	.....	.....	....	....	....	Throat clear; July 21, typical signs of mitral endocarditis. Discharged relieved Aug. 16.

CASE 28.

SCARLATINA.

Boy, 3 years. Previously an attack of pertussis. Present illness: Onset June 10, with sore throat, vomiting, fever, and rash.

Physical examination June 11: Robust, no prostration. Little nasal discharge; papillae large and red; throat reddened, no exudate; no rash on roof; punctate eruption over body. Temperature 98.5°. Urine: no albumin June 12, 21, 25.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 11	2	98.5	85	12,800	5,068,000	44	50	4.75	0.50	0.75	
" 13	4	98.5	..	16,400	.....	79	19	2	0	0	Rash gone; desquamation on face.
" 15	6	98.5	..	18,300	.....	66	32	2	0	0	No symptoms; very mild case.
" 17	8	98.3	..	14,500	.....	68.50	29.50	1	0.25	0.75	Slight desquamation.
" 20	11	101	70	15,100	.....	82.25	15.75	1	1	0	Cervical lymph nodes enlarged and tender.
" 23	14	99.1	70	14,600	4,771,000	63.50	31.25	3.50	1	0.75	
" 27	18	98.5	..	18,600	.....	61.75	35.25	1.75	1	1.25	Still desquamating.
July 1	22	98.4	70	13,100	.....	35	63	1	0.50	0.50	
" 6	27	....	70	13,200	4,579,000	66.25	31.75	1	1	0	
" 18	39	....	65	10,400	4,864,000	46.25	51	2.75	0	0	Discharged well July 31.

CASE 29.

SCARLATINA; NEPHRITIS.

Girl, 11 years. Measles eight years ago. Present illness began June 10 with vomiting and sore throat.

Physical examination June 12: Vigorous child, considerable prostration. Throat red, no exudate; raspberry tongue; punctate rash on roof of mouth; brilliant punctate eruption of scarlatina over body, emphasized in the flexures. Heart rapid, not enlarged, systolic at apex. Pulmonary second sound accentuated. A few small lymph nodes in neck.

Date	Day disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast-cells	Remarks
June 13	4	103	..	18,400	.....	90	8.25	1.75	0	0	No albumin in urine.
" 16	7	100.1	75	15,800	4,339,000	..	..	..	..	..	Rash nearly gone.
" 18	9	100	..	19,200	.....	69.50	23.50	4	1	2	Desquamation on hands and feet.
" 21	12	99	..	17,000	.....	60.25	36	3	0	2.75	Extensive desquamation.
" 24	15	102.2	..	15,000	.....	71.25	22.25	3.75	.25	2.50	
" 25	16	103.5	..	19,400	.....	85.75	13.50	.50	0	.25	Inflammation of glands in right side of neck.
" 28	19	98.4	70	22,600	4,492,000	81.25	16.25	1.50	.25	.75	Slight trace albumin in urine since 26th; glands less inflamed.
July 2	23	99.2	..	21,500	.....	83.75	13	2.75	.25	.25	Profuse desquamation; urine 12 oz.; trace albumin; symptoms of nephritis.
" 6	27	100	60	16,500	.....	76	16.50	5.50	0	2	Severe nephritic symptoms; urine typical of nephritis; rectal feeding.
" 10	31	101.1	..	29,600	.....	88	11.25	0	0	.75	Very sick.
" 14	35	100	70	19,700	4,792,000	88.25	11	.50	.25	0	Somewhat improved.
" 18	39	....	..	14,300	.....	71.50	28	.50	0	0	
" 22	43	....	55	13,500	.....	68	31.75	.25	0	0	Discharge from right ear since the 19th; improving.
" 28	49	....	55	12,300	3,277,000	61	37.50	.25	.25	1	Much improved.
Aug. 8	60	....	60	..	3,824,000	..	..	..	..	..	Discharged well Sept. 3.

CASE 30.

SCARLATINA.

Woman, 23 years. Pertussis in childhood. Present illness: Onset June 2, with sore throat, chill, vomiting, and fever.

Physical examination June 5: Well developed and nourished. Throat red; exudate on tonsils; papillae enlarged; rash on roof; fairly bright punctate erythema over body; lymph nodes in neck not enlarged. Heart normal. Temperature 103.3°. Urine: June 6, slight trace albumin with a few casts; July 8, slightest possible trace albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mononuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 6	5	101.5	..	9,500	.....	81	18	1	0	0	Vaccination.
" 8	7	100	..	9,300	.....	56	40.50	3.50	0	0	Rash normal.
" 11	10	98.4	..	6,900	.....	66.75	33.25	0	0	0	
" 14	13	98.5	85	6,400	4,624,000	54.50	42.50	2	0	1	Free desquamation beginning yesterday.
" 18	17	98.2	..	9,100	.....	45	43.25	10.50	0	1.25	
" 24	23	....	85	9,500	.....	70.50	25.50	1	2	1	Still marked desquamation. Discharged.

CASE 31.

SCARLATINA WITH RELAPSE.

Boy, 4 years. Pertussis eight months ago. Present illness: April 26, sore throat, high fever, and vomiting.

Physical examination, April 27: Papillae of tongue enlarged; thin membrane on both tonsils; profuse serous nasal discharge, cultures negative. No rash. Temperature 100.3°. April 30, a punctate eruption on body and hard palate, characteristic of scarlatina, appeared. The desquamation, which began May 2, was also typical. Disease ran normal course and on June 15 desquamation was over. June 19, fever of 102° and typical punctate erythema on whole body and hard palate, brilliant on thighs, feet, and lower abdomen. Fauces red, no exudate, papillae prominent; lymph nodes under left jaw enlarged. Urine: June 22, no albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mononuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 19	1	102	60	10,700	4,640,000	75	23.25	1.75	0	0	
" 21	3	103.3	..	12,000	.....	76	22.50	1.0	0	0.50	Rash bright on legs; beginning desquamation on face; throat reddened.
" 23	5	102	..	17,100	.....	69.25	29.25	1	0	0.25	Rash still visible on legs.
" 25	7	101	65	14,200	.....	50	43	6.25	0	0.75	
" 27	9	101.7	..	10,300	.....	59.50	36	4.50	0	0	Cervical lymph nodes enlarged; desquamation only on face.
" 29	11	100	65	18,400	4,272,000	62.50	30.50	5	0.75	1.25	
July 2	14	99.4	..	15,400	.....	56	37.75	5.25	0.50	0.50	Slight desquamation on legs and feet.
" 6	18	98.5	65	10,000	.....	45.25	51	3	0.25	0.50	Typical desquamation on feet and legs.
" 10	22	99.1	60	12,200	4,525,000	39	55.50	4.75	0.25	0.50	
" 17	29	98.5	65	6,900	.....	18.50	71	8.50	0.75	0.25	Discharged well Aug. 5.

CASE 32.

SCARLATINA.

Girl, 4 years. Measles one year ago. Present illness: Onset June 5 with headache, vomiting and fever.

Physical examination June 9: Robust child; extreme prostration, cyanosis and dyspnea; profuse purulent nasal discharge; tongue and throat typical of scarlatina; typical dark red punctate eruption on body; lymph nodes in neck greatly swollen with diffuse induration. Heart weak and rapid; moist râles. Spleen palpable. Temperature 100°. Cultures negative.

Blood examination June 9. White cells 18,500.

Temperature rose to 105° on June 10 and death occurred at 2 P. M. No autopsy.

CASE 33.

SCARLATINA; NEPHRITIS.

Girl, 5 years. Pertussis and measles one year ago. Present illness: Diphtheria March 23, treated in the hospital. April 21: Typical rash of scarlatina with strawberry tongue. Urine: April 21 and 28, no albumin.

May 9, edema of face; vomiting; urine contains over ½% of albumin. May 10, ½%, May 13, large trace; May 16, a trace with some blood and a few casts; less edema and vomiting. May 20; urine, slight trace albumin. Patient fed by mouth; no vomiting. Temperature 98.5°.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
May 20	29	98.5	..	19,800	.....	..	..	..	..	..
" 28	37	99	..	20,000	.....	45.50	50	4.50	0	0	No albumin in the urine.
June 8	48	99	..	17,200	.....	49	42.75	8.25	0	0	Discharged well, June 12.

CASE 34.

TYPHOID FEVER IN CONVALESCENCE FROM SCARLATINA.

Girl, 8½ years. Measles, varicella, and pertussis six years ago. Present illness: Began May 20 with fever, cough, and rash on body.

Physical examination, June 10: Emaciated, pale, weak, apathetic; papillae large and red; throat somewhat red; on hand, forearms and abdomen desquamation of scarlatina; profuse and typical. Soft systolic murmur. Spleen not felt. Rales both cases. Urine, slight trace albumin.

Date	Day Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Erythrocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 10	22	102	..	5,400	.....	..	..	..	..	..
" 13	25	103.6	..	6,000	.....	56	44	0	0	0	Symptoms suggesting typhoid.
" 18	30	98.5	60	5,600	.....	56	43.25	0.75	0	0	Rose spots; enlarged spleen; aggl. test positive.
" 26	38	101.3	60	18,900	.....	70.75	29	0	0	0.25	Adenitis colli.
July 1	43	102	..	8,100	.....	71	26	3	0	0	Relapse of typhoid.
" 9	51	100	55	10,400	.....	69.50	30	0.50	0	0	Rash nearly gone.
" 17	59	98.5	55	9,200	.....	65	33.75	1	0	0.25	Adenitis colli since the 11th; abscess opened and pus evacuated.

CASE 35.

SCARLATINA DURING CONVALESCENCE FROM MEASLES.

Boy, 5 years. Entered June 10, with measles, which ran the usual course. June 23, convalescence being established, the patient complained of sore throat, headache, and nausea.

Physical examination: Well developed and nourished boy. Erythematous rash over neck and chest, in places punctate. Throat reddened but without exudate; papillae of tongue swollen.

Date	Day	Disease	Temperature	Hemoglobin	Leucocytes per c.mm.	Enthocytes per c.mm.	Polynuclears	Mono-nuclears	Eosinophiles	Myelocytes	Mast Cells	Remarks
June 10	10	..	....	..	7,800	.....	....	....	....	....	....
" 14	14	..	....	..	6,700	.....	....	....	....	....	....
" 17	17	..	....	..	9,800	.....	....	....	....	....	....
" 20	20	..	....	..	11,400	.....	....	....	....	....	....
" 23	23	..	99.3	..	17,000	.....	73.50	23.75	2.5	0	0.25	
" 26	26	..	99.5	75	6,700	.....	64.25	30.75	4.25	0	0.75	
" 28	28	1	104	..	21,600	.....	79.25	19	1.75	0	0	Typical signs and symptoms scarlet fever.
" 30	30	3	99.2	65	25,600	4,644,000	89.75	8.75	1.25	0	0.25	Brilliant rash.
July 2	2	5	101	..	18,600	.....	66.25	27	6.75	0	0	Desquamation begins, but rash still visible; conjunctivitis.
" 3	3	6	99.3	..	18,800	.....	67.25	29	3	0.25	0.50	
" 5	5	8	99.8	..	19,300	.....	59.75	35.25	4.50	0	0.50	
" 8	8	11	100	..	13,800	.....	56.75	38.25	5	0	0	Euphoria.
" 11	11	14	98.5	70	10,400	5,238,000	51.25	43	5	0	0.75	Typical desquamation; good convalescence.
" 15	15	18	99.4	..	13,000	.....	47.75	47.75	3.50	0	1	
" 19	19	22	99	65	9,500	.....	40.75	53	5.50	0	0.75	
" 25	25	28	98.5	75	13,600	5,108,000	47.50	46	6.50	0	0	Discharged well Aug. 20.

SUMMARY OF RESULTS.

For purposes of blood examination several authors (Kotschetkow, Bowie, and Klotz), have divided their cases into three groups, i. e., 1) mild, 2) moderate, and 3) severe, usually fatal, and grouping ours thus we find 16 of the first, 11 of the second, and 5 of the third type. A close examination of our cases thus grouped, however, fails to give the constant results obtained by these authors, and it seems to us more reasonable to establish standards for the average case of scarlatina, noting the exceptions when the disease is of the very mild or extremely severe type.

As Tileston has emphasized, any attempt at definite deduction regarding the number of white cells occurring in the course of any disease must take into consideration the normal variations from year to year in infancy and early childhood. He states that the normal number of leucocytes in infancy varies from 10,000 to 15,000 per c.mm., dropping to about 12,000 per c.mm. in the second year and slowly decreasing to reach the normal

adult value (7,500 to 10,000 per c.mm.) at the tenth year. In children the lymphocytes are somewhat increased with a corresponding decrease in the polynuclears as compared with adults, while slight or unknown causes produce marked changes. Bearing these facts in mind we sought to tabulate our results by years, but found only insignificant differences, and therefore combined all cases over two years of age. In general the youngest children showed slightly higher counts, with somewhat more abrupt changes in the curve and in a few instances a high percentage of mononuclear cells.

HEMOGLOBIN.

The changes in the percentage of hemoglobin are somewhat irregular, but commonly the value is at the beginning normal, later showing a tendency to a gradual decrease. In several of the mild as well as the moderately severe cases no appreciable diminution could be made out while in others a loss of from 5 to 20 per cent was noted; the severe cases, so far as studied, were uniformly accompanied by a loss of from 10 to 25 per cent.

Complications, especially diphtheria and nephritis, often produce an abrupt loss in a few days of from 5 to 20 per cent. Our experience in this regard agrees with that of Widowitz as opposed to Reckzeh who asserts that complications exert no influence in lowering the hemoglobin.

In uncomplicated cases the loss is very gradual occasionally reaching its lowest point only after several weeks and more slowly mounting up to normal during convalescence.

ERYTHROCYTES.

With our series of 35 cases the changes in the red cells were much less definite and constant than those described by several authors. Every case of Reckzeh showed variations in the size of the erythrocytes and many a slight polychromatophilia; Berg mentions a count of 3,500,000 c.mm. as frequent; Kotschekow says in all his cases the red count sank to 3,000,000 per c.mm. or lower, increasing again not earlier than the sixth week; Hayem's loss in the number of red cells was about 1,000,000, the lowest count coinciding with the fall of temperature; Mackie found three and one-half to four million cells in about one-half of his 25 cases.

Unfortunately, as will be seen upon examination of the foregoing tables, the red counts were made with much less regularity than the white counts and consequently less definite deductions are possible. At the onset the number of erythrocytes was almost invariably normal (4,300,000 to 5,600,000 per c.mm.). During the first few weeks of the disease their course varies with the severity of the condition, in very mild cases usually not diminishing at all or even increasing, in the cases of moderate severity sometimes falling from 100,000 to 700,000 per c.mm., and in the severe types sinking much more abruptly and constantly though in no instance more than 700,000. Among the uncomplicated cases the lowest count recorded is 3,700,000 per c.mm., Case 8, a somewhat debilitated, rhachitic child of two and one-half years. Rarely in the cases with grave symptoms, either from a prolonged course or complications, very moderate variations in the size and shape of the cells were evident and in one or two such, a few normoblasts were found, but no other abnormalities in the erythrocytes showed themselves.

LEUCOCYTES.

Total count.—The chief interest and importance in the blood changes in scarlatina center about the white cells and here our records, comprising 366 counts with 348 differential determinations are, we believe, more complete than any recorded previously. Only one observation was possible previous to the onset of symptoms hence we are able to offer no data as to the behavior of the leucocytes during the incubation stage.

Our tabulated results at first sight give the impression of a very disappointing lack of uniformity in the course of the leucocytes, but after eliminating such counts as may be influenced by complications, and a few striking exceptions in the very mild and the fatal cases, the counts are surprisingly uniform. The series shows a constant leucocytosis, as a rule of marked type in the cases of moderate severity, somewhat less so in both the mild and the very severe fatal cases. The degree of leucocytosis varies so much with the stage and severity of the disease that any general exact statement of the white count in scarlatina is impossible; therefore, in an attempt to represent the course of the white

count in the various stages of the disease we have combined the above tabulated results into a composite curve (Table 1), excluding all such counts as appear to be influenced by complications or other conditions. Though obviously in some respects inaccurate, and differing somewhat from the course in individual instances, it clearly represents in the most accurate manner possible the average. It will be seen on reference to Table I that the leucocytosis rises somewhat during the first two days (16,000 to 17,000 per c.mm.), then more suddenly on the third to its maximum (23,000 per c.mm.), when it slightly less abruptly falls on the fourth and fifth, to rise again to 21,400 on the 11th. Subsequently the general course is irregularly downward, till at the end of the third week the count becomes about 12 to 14,000 per c.mm. During the fourth and fifth weeks the curve is irregular, but with a general tendency upward. The white count finally approximates normal limits in the sixth or seventh week. To this general course are several striking exceptions in the cases tabulated in the earlier part of this paper. The cases of a very mild type as a rule show a less intense leucocytosis and of shorter duration than the above, while many of the very severe ones, on the other hand, give much higher values, and are sustained for a longer time. Case 30 of our series, an adult with very mild symptoms, throughout the course of the disease maintained a normal leucocytosis. In Case 2 the white cells rose to 26,000 per c.mm. on the third day, falling to 13,900 on the sixth; in Case 3 to 44,000, also on the third day, sinking to 26,000 on the sixth; in Case 27 to 26,000 on the second day and subsequently falling very gradually to 15,000 on the 18th day. These three cases were all young children in whom the rash was brilliant, but the symptoms very mild. Cases 17, 18, and 19 strangely enough all gave their maximum leucocytosis on the 11th day, the counts being respectively 47,000, 31,900, and 25,700 per c.mm. since all are of the moderately severe type, no explanation is evident from the clinical side, in two cases the temperature being normal and the course in each case favorable. The maximum count in Case 8, occurred on the eighth day, rising from 16,600 on the fifth to 34,600 at the end of three days. The

following increase in the white count in Case 3, during the later course of the disease, and without apparent cause, is interesting:

Day of Disease	White Count
24	23,900
30	34,300
36	79,500
43	46,900
49	21,600

The above count of 79,500 c.mm. is the highest noted in our series in the uncomplicated cases. Reckzeh mentions one of 41,000, Klotz one of 78,000, while Klein made a single count of 80,000.

Kotschekow, Reckzeh, and Sacquépée agree in their opinion that the amount of leucocytosis bears no direct relation to the severity of the disease; while Mackie, on the other hand, records exactly opposite findings. Though not absolutely constant, our cases, within certain limits, give a definite relation as mentioned by Mackie. The time of duration of leucocytosis is generally conceded to bear a direct relation to the gravity of the symptoms. The maximum leucocytosis seems to correspond quite closely in time with the highest temperature, but appears from one to two days earlier and persists from a few days to several weeks longer, and during the course of the disease is not influenced by the character of the fever curve. All writers appear to be in agreement on this point.

Like Reckzeh, we have never seen the secondary rise in the number of leucocytes which Türk described as occurring at the height of the fever.

Differential count.—The course of the different kinds of leucocytes presents considerable variation in a few individual cases, as is true of the total leucocytosis, yet, considered together, the cases conform to a uniform type. The polynuclears are, during the first few days of the disease, relatively much increased, reaching the maximum (80 to 95 per cent) on the second to eighth day, to fall abruptly, then gradually to normal or subnormal at the end of the third to sixth week. Absolutely these cells at first take almost precisely the same course, but later fall more rapidly. During the first week the absolute value runs parallel with the

total leucocytosis, but subsequently sinks more abruptly, due to the increase in the mononuclears. Never, however, in contrast to the percentage value, does the number of neutrophiles become subnormal. Both relatively and absolutely the mononuclear cells take a direction complementary to the polynuclears. From a normal percentage at the onset they quickly fall on the second to fourth day to even 4 or 5 per cent in extreme cases, rise to normal during the next few days, and for the following few weeks more slowly to 50 per cent or higher (Case 4, 74.75 per cent). Convalescence is thus characterized by a mononucleosis which persists for many weeks. As a rule the absolute number of mononuclear leucocytes is at first slightly increased, and throughout the remainder of the disease greatly so. With the constantly falling leucocytosis after the initial rise it is obvious that the actual increase in the number of mononuclears must be less marked than the rise in percentage. It will be readily seen from the above that the initial leucocytosis is chiefly a polynucleosis, while later the mononuclears participate more and more in the increase of white cells.

The eosinophiles in our experience, are in the beginning either absent or much diminished but soon rise to slightly above normal values, often on the fourth or fifth day as high as 5 or 6 per cent. Even during convalescence a continued or temporary high value is sometimes met. In Case 1 the eosins were relatively increased throughout, on the ninth and eleventh day reaching 11 per cent; Case 14 showed 11 per cent on the fifth day; Case 30, 10 per cent on the seventeenth day. These changes just described agree in their essential features with the results published by previous workers.

In Table 1 we have included, beside the leucocyte curve, the composite curves of the absolute values of the three main types of white cells, and in Table 2 their relative values. Table 3 represents the results of the differential counts in Case 35.

No especial changes in the percentage of mast cells has been noted in this series except occasionally a slight decrease in the early stages of the disease followed in convalescence by a material increase.

TABLE 1.

COMPOSITE CURVES SHOWING THE COURSE OF THE TOTAL LEUCOCYTOSIS AS WELL AS THAT OF THE VARIOUS TYPES OF WHITE CELLS IN SCARLATINA.

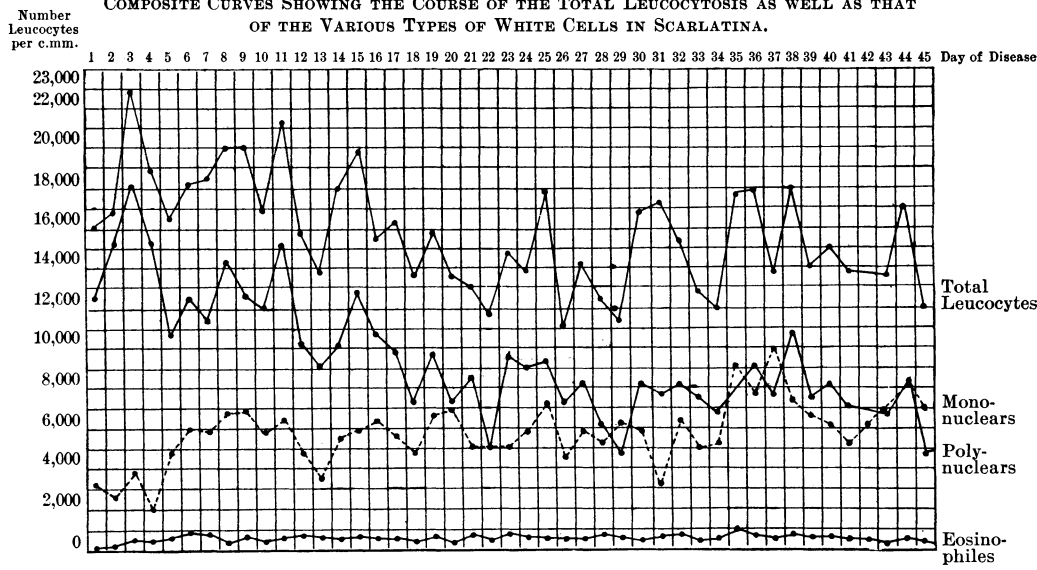


TABLE 2.

COMPOSITE CURVES SHOWING THE COURSE TAKEN BY THE RELATIVE VALUES OF THE POLYNUCLEARS, MONONUCLEARS AND EOSINOPHILES IN SCARLATINA.

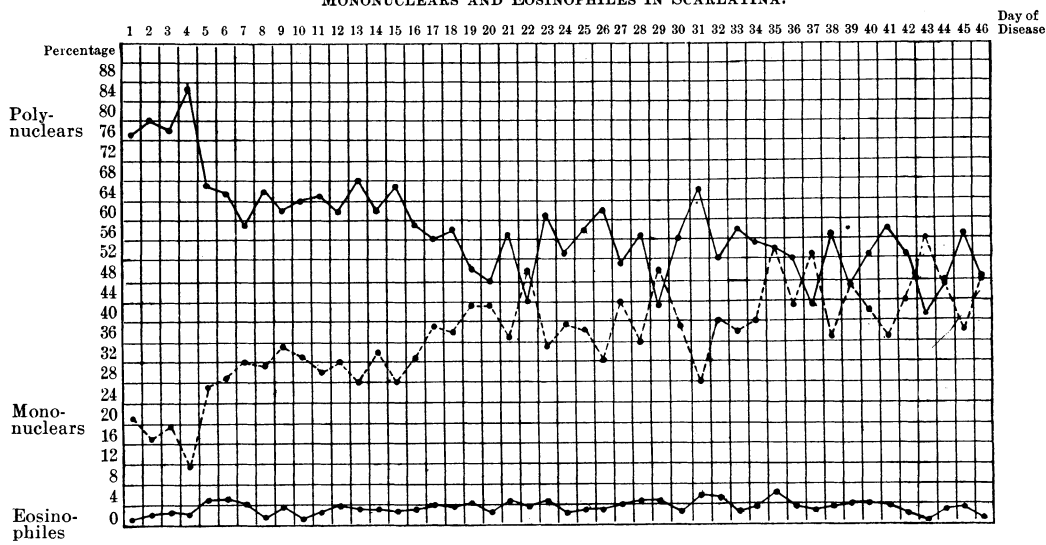
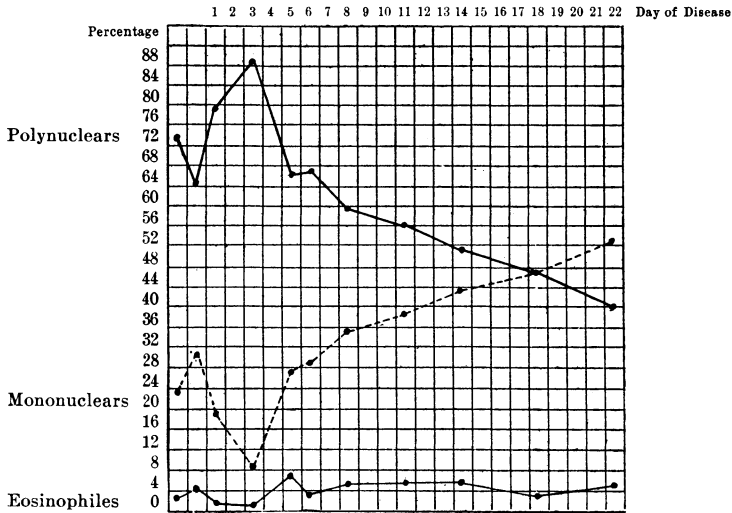


TABLE 3.

CASE 25.—This chart represents the variations in the polynuclears, mononuclears, and eosinophiles throughout the disease.



At the time of making the differential counts, the blood platelets in all cases were noted as diminished, normal or increased. Their number seems to be extremely variable and without constant relation to the period or severity of the disease, although in several instances they were distinctly increased during early desquamation. Türk states positively that the plates are increased during this period.

COMPLICATIONS.

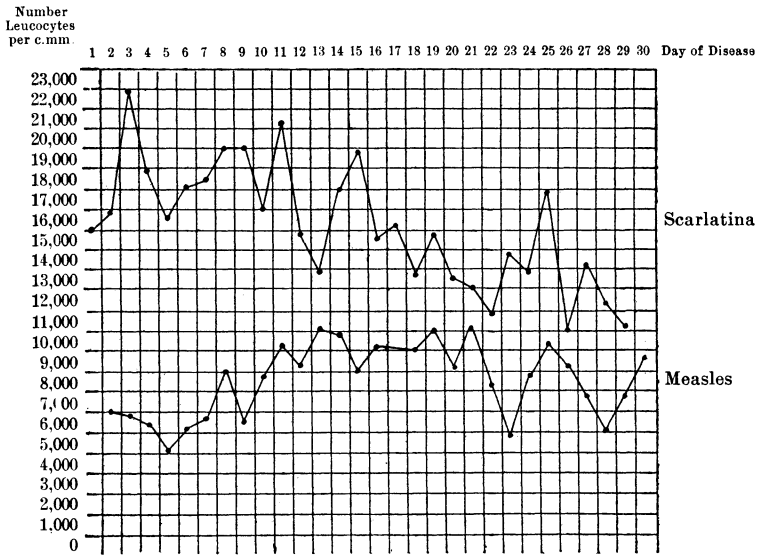
Our study of the diseases occurring in the course of scarlatina with reference to any possible influence on the blood comprises the following:

Diseases.	Number of Cases.
Measles	1
Abscess	5
Endocarditis	2
Otitis media purulenta	3
“ “ serosa	1
Diphtheria	4
Acute Nephritis	3
Cervical Adenitis	10
Typhoid	1

On the whole the results are surprisingly negative, the cases of measles, local abscess, endocarditis, otitis media serosa, and typhoid producing no definite alterations in the blood. Of the remaining, two cases of otitis media purulenta (8, 19), gave a slight increase in the leucocytosis with a corresponding rise in the percentage of polynuclear leucocytes. One case of diphtheria (10) evidently produced similar changes but of only a very moderate degree. Case 9, following immediately the onset of symptoms of nephritis which developed on the 22d day of the disease, showed an increase in the number of leucocytes from 17,500 to 20,800 with an increase in the percentage of polynuclears from 67.50 to 72.50. Three days later the white count rose to 25,900 and the neutrophils to 74.25 per cent. With the subsidence in the symptoms both diminished rapidly. Very similar changes accompanied the course of the nephritis in Case 29 but since otitis media and cervical lymphadenitis were also present no deductions are possible. Of the 10 cases of cervical adenitis occurring in the course of scarlatina, three (12, 27, and 28) apparently produced a marked increase in the white count and neutrophils. Various complications and sequelae, by prolonging the course and adding to its severity naturally, induce a somewhat greater degree of anemia than is commonly present. Concerning the influence of these intercurrent diseases on the blood in scarlatina the various authors are somewhat at variance. Widowitz mentions the possibility of a sudden and marked diminution in the percentage of hemoglobin following the onset of nephritis. Kotschetkow and v. Berg believe that complicating lymphadenitis, otitis media and nephritis exert no influence on the number of leucocytes. Sacquépée in one case each of nephritis and adenophlegmon found a hyperleucocytosis accompanied by a polynucleosis, while in a case of mumps a mononucleosis developed. Two cases of nephritis observed by Reckzeh produced no obvious effect on the blood while endocarditis, diseases of the bones, gumboils and adenitis did induce a hyperleucocytosis. Adenitis, otitis and nephritis in Bowie's experience all augment the leucocytosis. Klotz states that lymphadenitis, arthritis, varicella and otitis show an increase of

4,000 to 12,000 in the number of white cells, the polynuclears showing the greatest change, and nephritis either an increase or decrease.

TABLE 4.



Composite leucocyte curve based upon 350 counts in 34 cases of scarlatina and 200 counts in 28 cases of measles, showing the striking difference in the course of the leucocytosis in the two diseases.

THE BLOOD IN MEASLES AND SCARLATINA.

Tileston has already discussed the differences in the blood in scarlatina and measles. The contrast in the course of the leucocytosis is very strikingly brought out in Table 4, the composite curves being made up from the 35 cases of scarlet fever included in this investigation, and the 28 of measles published by Tileston. It will be noted that the curves are almost complementary throughout, in the first case a persistent though gradually falling hyperleucocytosis followed by a gradual rise to normal. It is in this regard that the blood examination may occasionally be of considerable value in differentiating between these two diseases. Otherwise we must admit that the study of the blood in scarlet fever is of no advantage in diagnosis.

CONCLUSIONS.

1. The blood of scarlatina in children differs from that in adults only in proportion to the differences in normal blood at the different ages.

2. A slight secondary anemia is the rule in all but the very mild cases, varying directly with the severity and duration of the disease. The fall in hemoglobin is from 5 to 25 per cent and in the erythrocytes from 100,000 to 700,000 per c.mm. Both return to normal after a period of several weeks.

3. A hyperleucocytosis almost invariably accompanies the disease and runs a characteristic course. Rising abruptly on the second to eighth day (18,000 to 40,000 per c.mm.) the count falls rapidly for a few days then more gradually to reach normal in convalescence, usually at the end of from three to six weeks.

4. During the period of invasion and eruption the polynuclear leucocytes are both relatively and absolutely increased but decrease gradually with the fall in the leucocytosis till convalescence when they may become relatively, though never absolutely, below normal. The mononuclears take an exactly opposite course. With the onset the eosinophiles disappear entirely or are greatly reduced, to rise above normal when defervescence begins. This eosinophilia persists until late convalescence. Myelocytes are often seen in small numbers as in all infectious diseases.

5. Complications, with a few exceptions, exert no influence upon the course of the blood. If severe they may increase the anemia and in a few instances (nephritis and diphtheria) even produce a rise in the leucocytosis.

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